PATENT SPECIFICATION

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(19)

(54) IMPROVEMENTS RELATING TO NONSLIP SOLES FOR FOOTWEAR

(71) We, JALLATTE S.A., a Société Anonyme organised under the laws of France, of 30170 Saint-Hippolyte-Du-Fort, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to non-slip soles for footwear, particularly but not exclusively for safety footwear used by workmen, particularly on worksites.

It is commonly accepted that in order to prevent footwear from slipping on a smooth, greasy or wet surface the sole must comprise a multitude of contact zones whose individual surface is as small as possible.

Thus, when soles are provided with a series of studs whose surface in contact with the ground is grained, chequered and striated, the effective contact surface is greatly reduced and generally of the order of from 5 to 6 100ths of the total surface.

Finally, it must be emphasized that up to the present time attempts made in connection with non-slip soles have led to the arrangement of blocks or studs in lines transverse to the longitudinal axis of the soles, or in a herring-bone arrangement.

Since, despite all efforts, soles improved in this manner are not completely satisfactory from the point of view of the safety of workmen, the applicants, suspecting that present arrangements correspond more to subjective impressions than to scientific reality, decided to search systematically for the best arrangements.

Unfortunately, for lack of a testing machine accurately measuring the adhesion of a sole on a smooth surface, the situation remained confused until the time when the Institut National de la Recherche Scientifique (INRS) constructed a first measuring bench (report No. 011/RE/A of January 1972 drawn up by Messrs. Tisserand and Grosdemange).

This work cleared the way to a considerable extent for solution of the problem, and in particular made it possible:—

to determine the nature of the coefficient of adherence correctly characterising the sensation of adherence of a wearer, that is to say the dynamic coefficient of adherence, hereinafter designated μd;

to provide a measuring apparatus permitting correct determination of the coefficient μd on any kind of footwear, and also, with the aid of a modification, on standard test-pieces. Nevertheless, the aim of the INRS was the systematic comparison of soles already on the market. Since the soles on the market were all based on the arrangements indicated above, these comparative tests could not reveal optimum arrangements.

The Applicants, having had a similar testing machine constructed, undertook a series of tests, hereinafter described, not relating to soles alone but also to samples whose geometrical shape made it possible to elucidate general laws regarding the best arrangement to be adopted for the shape of the parts of the sole which are in contact with the ground.

According to the invention, in a non-slip sole for footwear provided with substantially rectangular projecting studs or blocks separated by channels extending longitudinally and transversely of the sole, the studs or blocks have their longitudinal axis substantially parallel to that of the sole and the ratio between the surface of support equivalent to the total ground-contacting surface of the studs or blocks on the ground, and the projection, when parallel to the ground, of the contour of the said sole is between 15:100 and 50:100.

Advantageously, in a sole of this kind, the arch zone is reduced to the minimum compatible with comfort by elongation of the heel and/or by extension of the front surface of the sole in the direction of the heel, the enlarged portion resulting from this reduction of the arch zone being provided with studs or blocks of the kind set forth above.

According to a further feature of the invention, the substantially rectangular studs or blocks have rectilinear edges perpendicular to the direction of displacement or elongation, that is to say at least at the shorter sides of the rectangles. Adherence of the studs or

blocks to the ground is thereby improved, particularly at low speed. These edges are preferably as sharp as possible, that is to say the radius of curvature of the connection of the front portion of the stud or block to the portion in contact with the ground should be as short as possible.

Finally, the surface of the studs or blocks which is in contact with the ground advantageously has irregularity whose grain is so fine as to be practically invisible to the naked eye. For this purpose it is advisable for the material of which this surface is composed to be a microporous foam, of which a plane section constitutes the surface of contact with the ground. The advantage of this irregularity, whose effectiveness has been proved by experiments which the Applicants carried out, probably results from the fact that the irregular structure permits contact with the ground at numerous but separate points and thus contributes towards increasing the actual surface in contact with the ground.

Netherlands Patent Specification No. 59,829 discloses a clog on the sole and/or heel of which there have been incorporated longitudinal bands or strips of a material having greater resistance to wear than wood, the sole and the heel being so shaped that their surface intended to come into contact with the ground is smaller than that of sections parallel to that surface. This clog does not have surfaces in contact with the ground which project in relation to the sole as a whole, and it appears from the description that the surface of the wear bands in contact with the ground increases in proportion as the sole wears. There is no discussion of the adherence to the ground of these wear bands or of the non-slip character of the sole. The only advantages ascribed to the clog sole are that longitudinal bands ensure better protection against wear than conventional transverse bands, that these bands have better tensile strength than transverse bands and entail less risk of catching on rough ground, and finally that protection during digging work is better because of the fact that wear bands are provided under the arch of the clog. The problem dealt with thus has nothing in common with the problems which the invention seeks to solve.

The invention will now be more fully described with reference to the accompanying drawings, in which:—

Figure 1 is a block diagram of the measuring apparatus used in the development of the invention;

Figure 2 is a diagram showing curves of coefficient of adherence plotted against pressure per unit area and relating to two series of measurements made with the apparatus of Figure 1; the curve G_1 relates to the direction of slip parallel to the larger dimension of the sample tested and the curve G_2 to the direction of slip transversely to the larger dimension;

Figures 3 and 4 show imprints of two samples;

Figure 5 is a view from above of a sole in accordance with the invention;

Figure 6 is a section on the line VI—VI in Figure 5, and

Figure 7 is a side view of the bottom portion of a boot or shoe provided with a sole whose length of arch has been reduced in order to obtain maximum benefit of the advantages of the invention.

Referring to Figure 1, the measuring apparatus comprises a plate 1 which is given a sinusoidal movement by mechanism 2 which converts rotation into translatory movement. A sole or boot C to be tested rests on the plate 1 and is connected by a rod 3 to a force detector in the form of an elastic bar and stress gauge 4 tending to hold it immobile in space. The force measured by the gauge is transmitted to an oscillograph 5 after amplification at 6. The results are photographically recorded at 7, the memory screen of the oscillograph. The apparatus is completed by an optical displacement detector 8, comprising a lamp and light cell, and a frequency meter 9. The boots or soles are subjected to pressure normal to the plane of the plate.

The Applicants carried out tests in which certain parameters, such as vulcanisation level, Shore hardness, carbon black concentration and viscoelastic properties were kept the same and varying only the normal pressure, for one and the same sample. Test-pieces with rectangular relief were examined.

A. Tests with variation of pressure

a) Direction of slip parallel to the longitudinal axis of the sample (curve G_1 in Fig. 2):

Normal force	Coefficient of adherence μd
90 kg	0.17
55 kg	0.25
30 kg	0.29

b) Direction of slip perpendicular to the longitudinal axis of the sample (curve G_2):

Normal force	Coefficient of adherence μd
90 kg	0.15
55 kg	0.18
30 kg	0.22

From these measurements, the curves G_1 and G_2 were plotted.

Analysis of the oscillograph traces and of these two curves showed:

a) that reduction of pressure per square

centimetre gave rise to an increase of the coefficient of adherence μd;

b) that, for the same pressure, reduction of the front-edge length led to an increase of the coefficient.

As a result of these observations, the Applicants subjected to a load of 72 kg:

1) a sole having striated blocks giving the actual imprint E_1 (Figure 3).

2) the same sole after the blocks had become smooth, actual imprint E_2 (Figure 4).

If S is the ratio between the actual surface area of support on the ground and the area of the projection onto the ground of the apparent contour of the sole, the following results are obtained:

imprint E_1	S= 6:100
imprint E_2	S=18:100

Thus, the striation of the blocks of the imprint E_1 leads to a very small surface area and consequently to very high pressures per unit area.

Conversely, in the case of the imprint E_2, the surface of support is much larger and the pressures are considerably lower.

Contrary to what is conventionally accepted, it follows that the use of smooth blocks improves the coefficient of adherence (substantially by 2 in the present case).

Tests made with a completely smooth sole in the presence of damp revealed the formation of liquid cushions which abruptly reduced the coefficient of adherence to very low values, confirming what is well known, namely that completely smooth soles are more slippery on smooth, damp ground than soles having studs or blocks. It then remained to define the upper limit of S for which the coefficient became stationary and even retrogressed.

It was also necessary to avoid the formation of a liquid cushion, or even to channel it away and evacuate it.

The Applicants then discovered a surprising factor which is in contradiction with generally accepted principles, namely that the larger dimension of the studs or blocks should not be located transversely, as is usually done, but should be so located longitudinally that channels are provided between the studs or blocks.

The sole E_3 (Figure 5) shows studs or blocks, such as $P_1 \ldots P_7$ which are spaced apart longitudinally and transversely and whose width l leaves between them channels, whose width l leaves between them channels, Ca_1, Ca_2 . . . , which permit any cushion of liquid to be guided away and evacuated.

Figure 6 shows a stud or block P_2 (which differs from the others only in respect of its dimensions) of the shape of a truncated pyramid which tapers towards the ground. To give the edges of the free faces of this truncated pyramid an acute or sharp, not rounded, character, machining after moulding may be employed.

To increase the ratio S and consequently the coefficient μd, it would be advantageous to use an entirely flat sole, that is without a heel. Because of the actual anatomy of the foot, however, the real surfaces of pressure on the ground would not be substantially increased by such a sole.

The Applicants, having observed that S=50:100 appeared to constitute the upper limit above which μd remains unchanged, it appeared to be possible to find a solution reconciling the various data by increasing the supporting surface in the region of the arch, that is to say by bringing the general shape of the sole closer to that of a clog sole.

In Figure 7, the traditional arch K_1 is shown by chain lines, while the arch K_2 adopted for the purposes of the invention is shown in full lines. The increase of surface is evident from the hatched zones separating the line K_1 and K_2. Studs or blocks of the kind described above should be provided in this zone. Under the sole, designated generally by 10, on which an upper 11 is secured in conventional manner (only the lower part of the upper is shown), studs or blocks 12 are provided which come into contact with the ground 13. The shape of these studs or blocks is that of the stud or block P_2 in Figure 6.

WHAT WE CLAIM IS:—

1. A non-slip sole, for footwear, provided with substantially rectangular projecting studs or blocks separated by channels extending longitudinally and transversely of the sole, wherein the studs or blocks have their longitudinal axis substantially parallel to that of the sole and the ratio between the surface of support equivalent to the total ground-contacting surface of the studs or blocks on the ground, and the projection, when parallel to the ground, of the contour of the said sole is between 15:100 and 50:100.

2. A sole according to Claim 1, of which the arch zone is reduced to the minimum compatible with comfort by lengthening the heel and/or by extending the front surface of the sole in the direction of the heel, the enlargement of the sole resulting from this reduction of the arch zone being provided with studs or blocks according to Claim 1.

3. A sole according to Claim 1, wherein the substantially rectangular studs or blocks have their longer sides substantially parallel to the longitudinal axis of the sole, the ratio between the shorter and longer sides of the rectangles being between 2 and 3.5.

4. A sole according to Claim 3, wherein the studs or blocks have rectilinear edges per-

pendicular to the direction of displacement, that is at least at the shorter sides of the said rectangles.

5. A sole according to Claim 4, wherein the said edges are as sharp as possible, the radius of curvature of the connection between the front portion of the stud or block and the portion in contact with the ground being as short as possible.

6. A sole according to any one of Claims 1 to 5, wherein the surface of the studs or blocks which is in contact with the ground has irregularities whose grain is sufficiently fine to be practically invisible to the naked eye.

7. A sole according to Claim 6, wherein the material of which it is composed is a microporous material of which a plane section constitutes the surface of contact with the ground.

8. A non-slip sole substantially as hereinbefore described with reference to Figures 6 and 7 of the accompanying drawings.

9. A safety boot or shoe having a sole according to any one of Claims 1 to 9.

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Fig.1

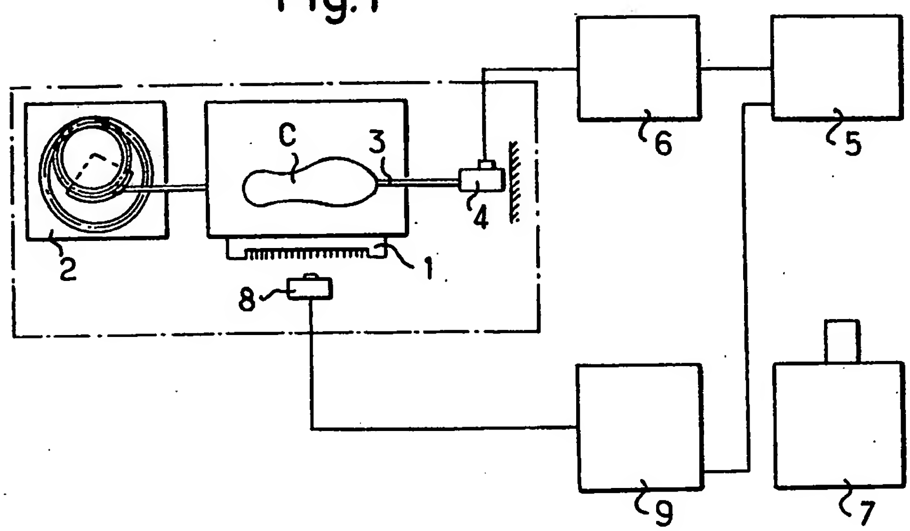
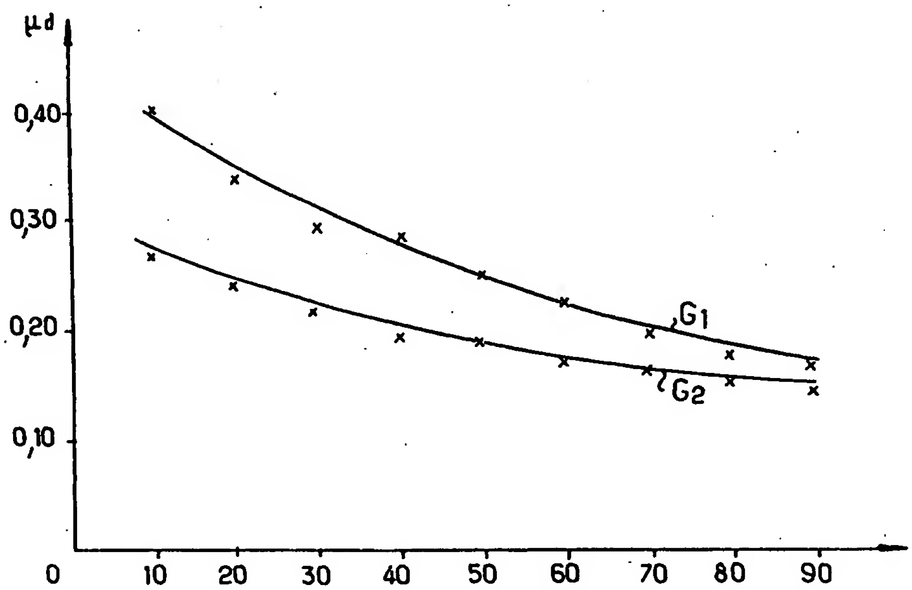


Fig. 2



1540982 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

SHEET 2

Fig.3

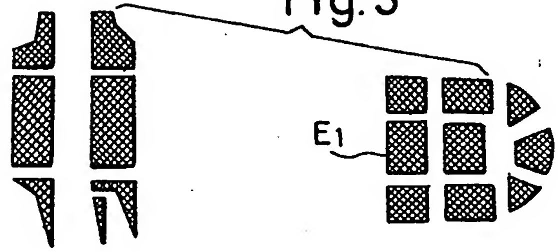


Fig.4

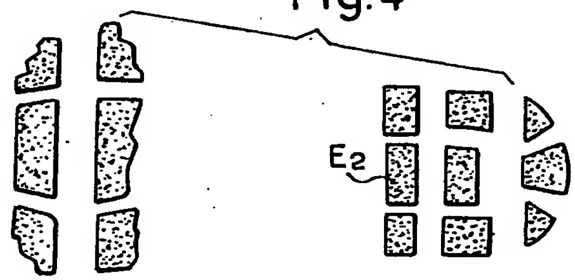


Fig.5

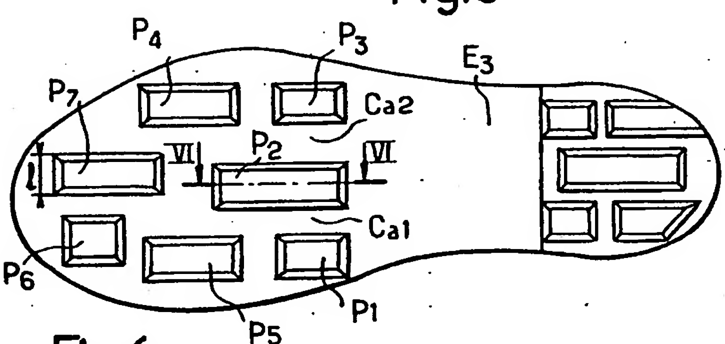


Fig.6

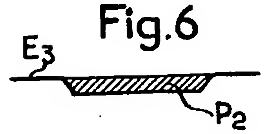


Fig.7